

PATENT

UNITED STATES APPLICATION FOR LETTERS PATENT

for

REMOTE NEWSPAPER VENDING MACHINE MONITORING

By

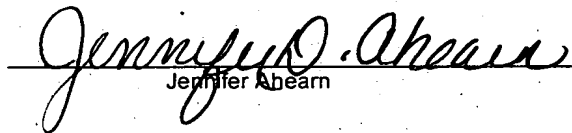
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Express Mail Receipt No. EL637787635US

Date of Deposit: October 3, 2003

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REMOTE NEWSPAPER VENDING MACHINE MONITORING

BACKGROUND OF THE INVENTION

5 This application is being filed concurrently with an application of the same inventors titled, "Newspaper Vending Machine Display", which application is incorporated herein by reference as though set forth herein in full.

10 **Field of the Invention**

 The present invention pertains to systems, apparatuses and techniques for enabling a vendor to remotely monitor the inventorsy status of one or more newspaper vending machines.

15 **Description of the Related Art**

 Figures 1A and 1B illustrate the type of newspaper vending machine that is, by far, the most common in the industry. As shown in these figures, this conventional newspaper vending machine 10 is essentially configured as a simple empty container 12 capable of storing a stack of newspapers at least 18 or 24 inches high, with a coin-box mechanism 14 (traditionally, entirely mechanical, but now sometimes electronic) that unlocks a locked access door 16 when an appropriate combination of coins is inserted. Once the access door has been unlocked, the purchaser can open it using handle 18 and retrieve a newspaper. Typically, the access door 16 is spring-loaded (although it may instead to be counter-weighted) such that once the purchaser releases handle 18, access door 16 returns to the closed position. In addition, the locking mechanism typically is configured so as to re-engage when the access door is closed, thereby automatically re-locking the vending machine 10. A coin-box door 19 typically can be unlocked using an ordinary key in order to retrieve the deposited coins, as well as to perform certain maintenance functions and to alter settings (e.g., the cost of the current edition of the newspaper).

Although more complicated newspaper vending machines have been proposed, in general they have been either too costly or too prone to malfunction and, therefore, have not become very popular. In any event, the present inventors has discovered that none of the existing or proposed conventional newspaper vending machines is well-suited to efficient and convenient monitoring of their inventorsies.

Several conventional systems permit local monitoring of the number of sales from a newspaper vending machine, as well as local monitoring of other conditions of the vending machine. Typically, in order to transfer this information such conventional systems utilize a short-range infrared link between the vending machine's coin box and a hand-held device. Examples of such conventional systems are the Sho-Rack TK-Electronic System™ sold by Kaspar Wire Works, Inc. and certain systems sold by Bellatrix Systems.

SUMMARY OF THE INVENTION

However, the present inventors have discovered that the foregoing systems have a number of drawbacks. For instance, they typically require a significant amount of special-purpose hardware and therefore are relatively expensive to implement. In addition, such systems still require a worker to physically visit each newspaper vending machine in order to obtain the information. As a result, for example, such systems are incapable of providing a notification when the inventorsy has been depleted or is below a specified level. Still further, such conventional systems generally are only capable of monitoring the number of sales made by the newspaper vending machine, as evidenced by signals received from the machine's coin box. Therefore, such conventional systems often are unable to detect a low-inventorsy condition that has resulted partially or wholly from theft.

The present invention addresses these problems by providing a newspaper vending machine that senses a low-inventorsy condition and transmits a message to that effect upon detection of the low-inventorsy condition.

Thus, in one aspect the invention is directed to a newspaper vending machine, that includes container means for storing a stack of newspapers.

Inventorsy means (such as a pressure sensor or a height sensor) is disposed within the container means and indicates a quantity of newspapers stacked in the container means. A transmission means is used for transmitting wireless messages, and control means coupled to the inventorsy means and to the
5 transmission means causes the transmission means to transmit a low-inventorsy wireless message upon a detection by the inventorsy means of a low-inventorsy condition.

By virtue of this arrangement, a newspaper vending machine according to the present invention often can be refilled more efficiently than conventional
10 newspaper vending machines permit, thereby avoiding missed sales. In more particularized aspects of the invention, the low-inventorsy messages transmitted via a cellular wireless system or via a satellite communications system. In this way, a wide-ranging network of newspaper vending machines often can be accommodated and managed through a central location.

15 In still further embodiments of the invention, the newspaper vending machine is provided additional sensors, such as an access door sensor, a coin-box sensor, a security camera and a tilted sensor. Information from such sensor is also can be transmitted for central processing.

In another aspect, the invention is directed to a system for monitoring
20 plural newspaper vending machines. Each of the newspaper vending machines includes: (i) container means for storing a stack of newspapers; (ii) inventorsy means disposed within the container means for indicating a quantity of newspapers in the container means; (iii) transmission means for transmitting wireless messages; and (iv) control means coupled to the inventorsy means and
25 to the transmission means for causing the transmission means to transmit a low-inventorsy wireless message upon a detection by the inventorsy means of a low-inventorsy condition. A base station receives the low-inventorsy wireless message and transmits a corresponding message to a pre-designated recipient via a cellular wireless network and/or a hard-wired network.

30 By virtue of this arrangement, the system is capable of flexible messaging and reporting of information received from a number of geographically dispersed newspaper vending machines. In more particularized aspects of the invention, the base station forwards the message to a report server, which may incorporate the information into its database, transmit real-time alerts, provide periodic

reports and/or permit queries for customized reports each. In addition, the report server may host a Web site that makes any or all of such information available and/or that permits users to download specified information to any or all of the networked newspaper vending machines.

5 The foregoing summary is intended merely to provide a brief description of the general nature of the invention. A more complete understanding of the invention can be obtained by referring to the claims and the following detailed description of the preferred embodiments in connection with the accompanying figures.

10 **BRIEF DESCRIPTION OF THE DRAWINGS**

 Figures 1A and 1B illustrate a common type of conventional newspaper vending machine.

 Figure 2A is a front/side perspective view of a newspaper vending machine retrofitted with a cellular wireless transmitter according to a
15 representative embodiment of the present invention.

 Figure 2B is a front/side perspective view of what of the newspaper vending machine shown in Figure 2A, with the container access door and the coin-box access door open.

 Figure 3 is a front/side perspective view of a newspaper vending machine
20 retrofitted with a satellite modem according to a representative embodiment of the present invention.

 Figure 4 is a top/rear perspective view of a newspaper vending machine according to a representative embodiment of the present invention.

 Figure 5 illustrates a block diagram of an apparatus that may be installed
25 in a newspaper vending machine for, among other things, transmitting low-inventorsy messages.

 Figure 6 illustrates a block diagram of a wireless-based network system in which a plurality of newspaper vending machines that have been configured according to the present invention may operate.

30 Figure 7A illustrates the use of a pressure sensor, Figure 7B illustrates the use of a mechanical height-measuring device, Figure 7C illustrates the use of an electric eye and Figure 7D illustrates the use of an electronic distance-

measuring device, in each case for detecting the amount of inventory in a newspaper vending machine according to various embodiments of the invention.

Figure 8 illustrates the use of a tilt sensor, alarm circuit and audible siren according to the present invention.

5 Figure 9A illustrates a left-side cross-sectional view of a newspaper vending machine that includes plural digital cameras that are triggered by the opening of the machine's access door, according to the present invention.

10 Figure 9B illustrates a top cross-sectional view of a portion of a newspaper vending machine where the access door connects to the main body of the vending machine.

Figure 10 illustrates a perspective view of a newspaper vending machine assembly that utilizes a security light and a visual display, according to a representative embodiment of the present invention.

15 Figure 11 illustrates a block diagram of an apparatus for use in the newspaper vending machine assembly shown in Figure 10.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Introduction

20 The present invention is particularly applicable to the type of newspaper vending machine shown in Figures 1A and 1B and described above. In fact, as will become apparent below, the present invention can be configured in such a way so as to permit easy retrofitting of such conventional newspaper vending machines.

25 One feature of the present invention is the provision of a wireless link (typically using radio, microwave, infrared or other electromagnetic wave propagation) to a base station (which typically serves as a central base station for receiving transmissions from multiple devices). Presently, it is preferred to communicate with the base station over a cellular communication system or via a satellite communication system. Generally speaking, some form of radio-frequency or possibly microwave communication is preferred, as these
30 technologies usually provide the most efficient solution for wirelessly communicating with a receiver that may be, for example, anywhere from 100 yards to 1-2 miles away, or even much farther away in the case of satellite

communications, and that may be obscured by buildings or other obstacles. Other technologies, such as infrared, generally are much more limited and therefore may not be appropriate in many cases.

Unlike conventional newspaper vending machine inventory-monitoring systems, the system of the present invention preferably uses a communications system that permits long-distance communications. The distance from the newspaper vending machine to the base station generally is not critical for providing such long-distance communications. This is because a cellular-based system having very small cells, or even micro-cells, or a system in which a great many access nodes are provided can significantly reduce the necessary distance between the two communication nodes. However, irrespective of the distance between the newspaper vending machine 10 and the base station, in order to provide for the type of long-distance and flexible communications contemplated by the present invention, the base station preferably is connected into (either directly or indirectly), and configured for communications via, a wide-ranging communications network. In preferred embodiments of the invention, that communications network also is publicly accessible. Examples include the Internet and/or the public switched telephone network (PSTN). However, some or all of the communications from the base station may be over private lines (e.g., dedicated cables and/or dedicated private channels within a network).

General Configuration of the Newspaper Vending Machine

An example of a newspaper vending machine 10 that has been provided with a cellular wireless transmitter is illustrated in Figures 2A and 2B. In Figure 2A, the access door 16 and the coin-box door 19 are both closed, while in Figure 2B both are open. As shown in Figures 2A and 2B, the newspaper vending machine 10 has mounted within it: a weight sensor 30 for detecting an indication of the weight of the stack of newspapers 13 in newspaper vending machine 10, a modem/processor box 90 for communicating via a cellular communications network, a whip antenna 92 connected to the modem/processor box 90, a door sensor 22 for detecting when the door 16 is open, a coin box sensor 24 for detecting when coin box 14 has been opened, and a battery 40 for powering the entire circuit.

More detail regarding each of these elements is provided below.

However, the door sensors (and any of a variety of other possible sensors, e.g., as described below) preferably are configured to provide an input to modem/processor box 90 which is then programmed to transmit real-time paging notices and/or periodic reports to a central base station (see Figure 6) upon the occurrence of specified conditions. For ease of illustration, electrical connections generally are not shown in Figures 2A and 2B, but instead are illustrated in Figure 5, which is discussed below.

10 An example of a newspaper vending machine 10 that has been retrofitted with a satellite modem is illustrated in Figure 3. As shown in Figure 3, the newspaper vending machine 10 in this embodiment of the invention has similar components to those in the embodiment illustrated in Figure 2. Thus, in this embodiment as well, newspaper vending machine 10 has mounted within it: a weight sensor 30 for detecting the amount of inventory in newspaper vending machine 10, an access door sensor 22 for detecting when the access door 16 is open, a coin-box sensor 24 for detecting when coin-box door 19 has been opened, and a battery 40 for powering the entire circuit. In this embodiment, however, a modem/processor 95 is provided and is configured for communication via a satellite link. Electrically coupled to modem/processor 95 is an external whip antenna 97 which preferably is encased in polyvinylchloride (PVC).

As will become apparent below, the foregoing two embodiments are structurally very similar. In fact, other than the selection of the modem/processor 95 and decisions regarding the type and placement of the antenna, as appropriate for the desired mode of communications, any differences between the foregoing embodiments generally will be discretionary nature, based upon the functionality desired to be achieved, or will be based upon limitations in the individual components selected.

Figure 4 illustrates the top surface of newspaper vending machine 10. Fitted onto such top surface is a unit 99 that may be, for example, a solar panel or a radio antenna (such as a low-profile satellite antenna for use in the satellite communications embodiment described above). In the preferred embodiment of the invention, unit 99 is a solar panel for recharging battery 40. This preference

is based upon the availability of lower-cost antennas and the desirability of having a power source for recharging the system's battery.

It is noted that in embodiments where satellite communications are employed, it generally will be preferable or necessary to use an external antenna. This particularly may be the case where newspaper vending machine 10 primarily is constructed in significant part using metal, which is the case with most currently available newspaper vending machines.

Otherwise, in either of the foregoing embodiments, placement of the individual components is not critical. Rather, such components may be placed anywhere within newspaper vending machine 10 where there is adequate space. Also, to the extent possible, it is preferable to make such components inaccessible to customers of the vending machine 10. Generally, this will mean mounting such components in portions of vending machine 10 other than container 12.

The choice between cellular or satellite communications, or any other wireless communication system for that matter, generally will be made based upon feasibility and price considerations. For example, satellite communications generally are not effective where the newspaper vending machine 10 is located indoors. Otherwise, data transmissions via a satellite link currently is preferable because it is less expensive than cellular communications for the desired purposes.

As indicated, satellite and/or cellular communications currently are preferred. However, as technology and infrastructure changes and improves other options may become more attractive. For example, if adequate coverage of publicly accessible 802.11x Internet access points (Internet hotspots) becomes available, communication of status information pertaining to newspaper vending machine 10 in this manner may become the preferred mode of communication.

30 *System Overview*

Figure 5 illustrates a block diagram of a system 20 according to a representative embodiment of the present invention, which may encompass, for example, either of the foregoing embodiments. The heart of system 20 is a modem/processor box 100 and that includes a processor 102 (which preferably

is user-programmable) and a combination modem/transmitter 104 (which may be implemented as a modem/transceiver by the addition of a receiver) for wirelessly communicating with a base station (e.g., as shown in Figure 6 below). Any of a variety of different processors 102, programmable in any of a variety of different programming languages, may be utilized.

Processor 102 preferably includes multiple inputs for receiving signals from the various sensors illustrated in Figure 5, any sub-combination thereof, and/or any other sensors. Such inputs may be polled by processor 102 (e.g., using appropriate software commands to check their statuses) and/or may be configured as interrupts, altering the processing of the processor 102 without the need for any such programming instructions. The inputs to processor 102 may be digital (e.g., binary) or may be analog (in which case processor 102 preferably converts such analog signals into a multi-bit digital format for processing and/or transmission).

The primary purpose of modem/transmitter 104 is to transmit and, in the case of a transceiver, to also receive data from a remote base station (e.g., as shown in Figure 6 below). Accordingly, modem-transmitter 104 preferably is configured to accommodate such communications at the appropriate frequency and in the appropriate format for the chosen communications channel. As indicated above, it presently is preferred to utilize cellular wireless communication or satellite communication, with the former being preferred for indoor or other situations without a clear line-of-sight path to a satellite, and the latter being preferred otherwise. This preference, however, is solely due to the current costs and data transfer capabilities of the various available wireless communication system alternatives, and may well change over time as the relative merits of competing systems change.

In the presently preferred embodiments of the invention, the modem and processor are included within a single box 100. The cellular embodiment preferably uses a Telemetric™ T200 modem/processor 100 and the satellite communication embodiment preferably uses a Quake™ Q1500 modem/processor 100. A brief description of each of these modem/processor box is 100 is provided as follows.

The modem/transmitter 104 for the Telemetric™ T200 has transceiver capabilities, transmits in the 824-849 Megahertz (MHz) frequency band and

receives in the 869-894 MHz frequency band, over the Advanced Mobile Phone System (AMPS) analog cellular system, using the frequently non-utilized data field within AMPS. Its processor 102 is capable of monitoring and reporting the status of switches connected to its inputs, with triggering events occurring on either an open-to-closed or a closed-to-open transition. It also may be programmed to wait a specified period of time before declaring a trigger event (with a 5-second default) in order to avoid false alarms. In addition, the inputs can be software-configured as a pulse counter for accumulating the number of times a particular input switch has been opened or closed. Its processor 102 may be configured to generate reports on a regular schedule, by exception only, or any combination of these options. The Telemetric™ T200 includes an RS232 serial port for downloading programming instructions and for performing other communications (e.g., testing, radio configuration and/or system configuration) with an external computer (e.g., a handheld, laptop or desktop). A provided low-power mode conserves battery power but limits queries from the base station to periods when the transceiver 104 has initiated a data transmission.

The Quake™ Q1500 has a transceiver 104 that is configured for communications over the ORBCOMM satellite network (transmitting in the 148.00 to 150.00 MHz range and receiving in the 137.00 to 138.00 MHz range). In addition, it may optionally include a global positioning satellite (GPS) receiver. Its processor 102 includes 5 analog input ports for inputting signals in the range of 0 to 1 volt (V) and 8 digital configurable input/output ports (i.e., each may be software-configured as either an input or an output). The digital circuitry of its processor 102 operates at 3.3 V, and a 3.3 V output line rated at 0.5 amps is provided, thereby allowing simple mechanical switches to be used as input devices. Its processor 102 also may be configured for reporting on a regular schedule, reporting by exception only, or any combination of these two options. Generally speaking, activity in the Quake™ Q1500 is triggered by an event, which may be a timer-driven event (e.g., scheduled), an alarm-driven event (e.g., where one or more of the digital inputs is configured as an interrupt), or a query-driven event (e.g., from an externally connected computer or via the radio link). Upon the occurrence of any of the foregoing events, the processor 102 for the Quake™ Q1500 may be instructed to: sample one of the analog input signals, send a control signal to external equipment via a digital output line and/or

transmit a message via the radio link. The processor 102 of the Quake™ Q1500 also includes two RS232C ports for communicating with an external computer.

Antenna 106 preferably is chosen based upon operating frequency band, efficiency considerations, cost and transmission gain. Generally speaking, an internal whip antenna 92 may be utilized for a cellular wireless implementation, while an external whip antenna 97 or a low-profile external antenna (e.g., unit 99) may be utilized for satellite communications. Based on cost, as well as the present preference for using unit 99 as a solar cell, a whip antenna 97 is preferred for the satellite communication embodiment. Moreover, if newspaper vending machine 10 is primarily constructed of plastic (and an increasing number are in fact being formed of Acrylonitrile Butadiene Styrene, or ABS, plastic), then the whip antenna may be moved inside newspaper vending machine 10, even in the satellite communication embodiment.

A significant difference between a newspaper vending machine according to the preferred embodiments of the present invention and such conventional vending machines is the present invention's use of a relatively simple and easy-to-install inventory detection mechanism. Preferably, the amount of inventory in vending machine 10 is determined with the use of a weight/height sensor 35 mounted in newspaper vending machine 10, which is used for detecting the weight and/or height of the stack of newspapers (typically, an ordinary stack with no portion of the mechanism separating adjacent newspapers in the stack) within container 12. Any type of sensor may be used for this purpose, and particular examples include the weight sensor 30 mentioned above and/or any of the other weight/height sensors 35 described below in connection with the discussion of Figures 7A to 7D.

Another sensor included in newspaper vending machine 10 is door sensor 22 for detecting when door 16 is opened. In the preferred embodiments of the invention, sensor 22 consists of: (i) a magnetic reed switch mounted on a lip of newspaper vending machine 10 that abuts the top edge of door 16 when door 16 is closed; and (ii) a magnet encased in plastic or a piece of magnetic tape attached to the top edge of door 16. As a result, when door 16 is closed the magnet is proximate to the magnetic reed switch and therefore the reed switch contacts are opened, and when door 16 is opened the magnetic reed switch returns to its normally closed position. Alternatively, door sensor 22 instead may

be implemented as a simple mechanical switch (such as a pushbutton switch). As indicated, a normally closed switch is preferred, although a normally open switch may instead be used, provided the appropriate circuitry is used.

5 Coin-box sensor 24 preferably is implemented as a combination of a magnetic reed switch and either a plastic-coated magnet or a piece of magnetic tape, in the same manner as described above for door sensor 22. In this case, however, coin-box sensor 24 is used to detect an opening of the access door 19 for coin box 14.

10 A battery 40 is the main power source for the entire system 20. In the preferred embodiment of the invention, battery 40 is a 12-volt lead-acid battery, such as a conventional motorcycle battery. More preferably, battery 40 is a Power Source™ Sealed Lead Acid Maintenance-Free motorcycle battery sold by Lynn Vick Products™ of Anaheim, California. As indicated above, certain of the components of system 20 may be self-powered, e.g., with the use of an internal
15 battery. In addition, some of the components (e.g., the modem/processor box 100) may convert the power provided by battery 40 into a different voltage and may even output such converted voltage for use by other elements of system 20.

Although not strictly necessary, in the preferred embodiment of the invention a circuit 260 for recharging battery 40 is provided. For those cases in
20 which vending machine 10 is located indoors or is otherwise near an alternating current (AC) power source, the recharging circuit 260 may be selected to have functionality for converting the available AC voltage into the required direct current (DC) voltage for system 20. In such a case, charging circuit 260 may be any available off-the-shelf battery charger. However, in most cases vending
25 machine 10 will not have access to AC voltage.

Accordingly, a solar cell 240 preferably is provided for supplying the input power to charging circuit 260. Solar cell 240 preferably is a 12-volt DC 5-10 watt sealed solar panel. In this case, charging circuit 260 may consist of a simple diode (which may be included with solar cell 240) for preventing current from
30 flowing back toward solar cell 240. Alternatively, charging circuit 260 may be more complicated, regulating current flow and/or preventing over-charging. Where such charging control functionality is provided, it generally will be preferable to include a load 280 for drawing the excess current generated by solar cell 240. A load 280 may be a simple resistive element or may be an

element that utilizes the supplied power to provide light, to provide heat, to charge a backup battery, or to provide any other useful functionality.

Still further, the main battery 40 may be removed from vending machine 10 and taken to a central charging station when recharging is required. In such a case, an AC-powered charging circuit, such as described above, may be used for charging the batteries from the newspaper vending machines 10 one at a time. More preferably, however, in such cases the battery charger utilized at the central charging station is capable of charging multiple batteries at the same time, such as the Battery Tender™ Battery Management System, which is a fully automatic, constant-current and battery charger designed to charge and/or maintain up to 10 12-volt batteries simultaneously.

A further sensor included in newspaper vending machine 10 is tilt sensor 140 for detecting when newspaper vending machine 10 has been tilted. In the preferred embodiment of the invention, tilt sensor 140 is implemented as a simple normally closed pushbutton switch mounted on the bottom surface of newspaper vending machine 10 (preferably near the center of such bottom surface). See Figure 8, which is discussed below. As a result, a sufficient amount of tilting in any direction will cause the pushbutton switch to be lifted off of the ground, thereby causing its contacts to return to the normally closed position.

Alternatively, tilt sensor 140 may be implemented using one or more mercury (or similar liquid-based) switches. One advantage of such an alternate tilt sensor 140 is that it can be mounted nearly anywhere within newspaper vending machine 10. However, such switches generally only detect tilting in a single direction. Accordingly, in the embodiments where such switches are utilized it generally is preferable to use four such switches, connected in parallel if normally closed or in series if normally open, one for detecting tilt in each potential direction (i.e., x+, x-, y+ and y-).

Electrically connected to tilt sensor 140 is an alarm circuit 160 for driving an audible siren 165 in the event that tilt sensor 140 detects a tilt condition. Preferably, alarm circuit 160 includes a relay (or similar electronic switch) which, when triggered by a signal from tilt sensor 140, remains closed, causing alarm circuit 160 to continuously drive the siren even in the event of a temporary tilt condition of short duration. Optionally, alarm circuit 160 may also be provided

with a timer circuit to disable the alarm after a specified period of time. Subject to the foregoing preferences, any conventional alarm circuit 160 and siren 165 may be utilized, with a piezo siren being preferred.

5 Newspaper vending machine 10 preferably also is provided with a security camera 200 for capturing images of at least some customers of newspaper vending machine 10. The main purpose of security camera 200 is to capture images of any customers involved in theft of newspapers within vending machine 10, and in certain embodiments may also be used to capture images of any person vandalizing newspaper vending machine 10 and/or performing other
10 illegal activities.

In the preferred embodiments of the invention, security camera 200 is an ordinary digital camera for taking still pictures. However, any other type of camera may instead be used, such as a Webcam or a video camera. Security camera 200 is shown in Figure 5 as providing an input to processor 102, and as
15 a result, capture images may be uploaded to a central server in the event of a theft, tilt or similar event. Alternatively, it is possible for security camera 200 to be implemented as a stand-alone camera that records images to its internal memory, which is then manually accessed only in the event of a theft, tilt or similar event.

20 Still further, camera 200 may be provided with its own separate radio transceiver for transmitting images to a base station. One example of such a camera is the TCS-CAM GSM digital camera sold by DPS Promatic™ in Italy. This camera acts as a stand-alone monitoring station, transmitting digital images over standard Global System for Mobile Communications (GSM) data channels.
25 Provided proprietary software allows those images to be viewed on a standard personal computer connected to the Internet.

Optionally, system 20 also is provided with a processor 110 that works in conjunction with a short-range transceiver 112, transmitting and/or receiving over an antenna 114 for short-range wireless communications. A processor 110 may
30 be a general-purpose processor that is capable of providing a wide range of flexible functionality, depending upon how it is programmed. As a result, processor 110 may function as the central processor for system 20. Alternatively, processor 110 may be primarily dedicated to performing functionality for communicating via transceiver 112.

In this regard, transceiver 112 may permit wireless communications via infrared although, more preferably, such communications are in accordance with the Bluetooth, 802.11x or similar protocols. In this matter, system 20 is able to communicate with service personnel carrying a compatible handheld device
5 and/or with passersby having a compatible computer or other device. Some of the advantages of this capability are described in more detail below.

It is noted that in the configuration shown in Figure 5, processor 102 and modem/transmitter 104 are included in a single box 100, while processor 110 is shown as a separate element. However, this configuration is not critical period
10 processor 102 and modem/transmitter 104 may be implemented as truly separate components. Similarly, a single processor may perform all of the functionality of processor 102 and processor 110 shown in Figure 5. The precise configuration of system 20 preferably is based upon cost considerations, which will be largely driven by the availability of off-the-shelf components, as well as by
15 the capabilities of such components.

Network Overview

Figure 6 illustrates a block diagram of a system 300 in which a plurality of vending machines 10, each having a system 20 installed, may operate. More
20 specifically, each of the vending machines 10a and 10b shown in Figure 6 may be provided with a system 20 according to any of the variations and with any of the options described herein. Moreover, although only two newspaper vending machines 10a and 10b are illustrated in Figure 6, it should be understood that this is for ease of illustration only and, generally, a system 300 according to the
25 present invention will have many more interconnected newspaper vending machines 10. In the following discussion, vending machines 10A and 10B sometimes are collectively or individually referred to as newspaper vending machine 10, where no relevant distinction between individual machines exists.

As shown in Figure 6, each vending machine 10 in system 300 typically is
30 connected to a corresponding base station 301 via a wireless link 303. This link 303 may be, for example with respect to link 303A, a cellular link or a satellite link (e.g., using radio frequencies), or for example with respect to link 303B, a short-range radio link (e.g., Bluetooth or 801.11x). However, in certain cases, most notably where a particular newspaper vending machine 10 is installed

indoors, it may be possible to hardwire the newspaper vending machine 10 to its corresponding base station 301 (e.g., via the Internet) or in such cases even to omit to a base station 301 altogether (e.g., by using direct Internet communications between the vending machine 10 and the ultimate recipient).

5 Each base station 301 will correspond to the nature of the corresponding wireless link 303. Thus, for example, where cellular wireless communications are used, a given base station 301A typically will be a cellular base station; where satellite communications are used, base station 301A typically will be a satellite ground station, and where a short-range 802.11b link is used, base
10 station 301B typically will be a wireless hub. It is noted that the same type of wireless link 303 may be used for all vending machines 10 in system 300 or, alternatively, different types of wireless (or, as noted above, hardwired) links 303 may be used, depending upon the unique circumstances of each vending machine 10.

15 In any event, in the preferred embodiments of the invention, each base station 301 ultimately communicates with a server. In the case of cellular wireless communications or satellite communications, the base station 301A generally initially will communicate with a communications server 310 that is affiliated with the wireless communications system (e.g., either cellular or
20 satellite). Conventionally, such communications systems often utilize such a communications server 310 for receiving data messages from compatible modem/transmitters 104. These communications servers 310 often will provide a Web page through which customers of the system may configure how data communications between the communications server 310 and the customer's
25 modem/transmitters 104 are to be handled. For example, such a Web page may permit a customer to specify an e-mail address to which data transmissions from the customer's modem/transmitters 104 are to be forwarded (possibly, with different types of transmissions forwarded to different e-mail addresses).

 Accordingly, it is possible for the customer to configure its account with
30 communications server 310 so that any messages pertaining to the customer's newspaper vending machines 10 received by communications server 310 are directly forwarded to the individuals who are responsible for taking the appropriate action. However, in the preferred embodiments of the invention where such a communications server 310 is utilized are used (e.g., the cellular

and satellite communications embodiments), the e-mail (or other type of) address for communications from communications server 310 pertaining to the customer's modem/transmitters 104 instead is the address of a report server 325 that is maintained by the operator of the system 300 of linked newspaper vending machines 10 (i.e., the customer of the communications system that includes communications server 310). Such a configuration in which messages are forwarded from a communications server 310 that is maintained by a third-party communications system provider to a server 325 that is maintained by the same entity that operates the newspaper vending machines 10 generally allows greater flexibility in routing messages, processing reports, downloading software updates and controlling the operator's system 300 than would be provided by the often simple (or at least generic) capabilities provided by the communications server 310.

In these preferred embodiments, report server 325 will communicate with communications server 310 via network 320, which generally will be the Internet. However, if communications server 310 utilizes any other public or private network 320 for communicating with its customers, then report server 325 may be, or may be required to be, configured to communicate over such network 320.

Where a short-range RF link 303B is utilized, it may be possible to avoid a communications server 310 altogether and communicate directly with report server 325 via network 320 (preferably, the Internet). That is, newspaper vending machine 10B may directly e-mail (or otherwise communicate via the Internet with) report server 325. However, generally speaking, even where a newspaper vending machine 10 communicates via a short-range RF link 303B, the base station 301B will not have direct access to the Internet and instead must access the Internet through an Internet Service Provider (ISP). Such an ISP, however, will not function in the same manner as a server 310, but instead will merely act as a gateway to the Internet 320.

Report server 325, in turn, communicates via a network 330 (e.g., the Internet and/or a local area network) and/or via a cellular network 335 with various end users, such as end user 341 and end user 342. For example, report server 325 may be configured to forward a received message to a particular end user 341 or 342 based on the type of the received a message. Such a forwarding may take the form of an e-mail message directly through Internet 330

to end user 341 (e.g., operating an Internet-connected computer), a short message service (SMS) message directly via cellular network 335 to end user 342 (e.g., carrying a wireless cellular telephone or pager), or a SMS message routed initially over Internet 330 to a server operated by the cellular wireless provider and then over the cellular network 335 to end user 342 (e.g., carrying a wireless cellular telephone or pager).

All of the communication paths 351-358 and 361-365 are shown in Figure 6 as being bidirectional. At a minimum, system 300 preferably is capable of one-way communication from each of vending machines 10 to report server 325. More generally, system 300 preferably is capable of handling low-inventory and/or other messages generated and transmitted by newspaper vending machines 10. Ordinarily, many of these messages would be forwarded immediately or nearly immediately by report server 325 to end user 341 and/or 342, or the contents thereof may be incorporated into reports that are distributed to end user 341 and/or 342 on a periodic basis. For this purpose, the communications paths 351-358 from vending machines 10 to report server 325 need only be one-way. However, even in such embodiments, paths 361-365 (or at least some of them) preferably are bidirectional. In this manner, report server 325 may maintain records which can be queried by end users 341-342.

More preferably, communication links 351-358 also are bidirectional (as shown in Figure 6) so as to permit, for example, status queries, requests for other information (e.g., the number of sales made, the time that the coin box 14 was last emptied, and/or the number, height and/or weight of newspapers within the vending machine), software downloads, information downloads (e.g., for providing the height, weight and/or price of the current edition newspaper), and/or display information downloads (as described in more detail below) from report server 325 to any of the vending machines 10.

Thus, in the preferred embodiments, system 300 provides maximum flexibility in handling information generated by the sensors installed as part of system 20 in each vending machine 10. Specifically, that information is uploaded to server 325, either in real-time or on a periodic reporting basis. That information, in turn, may even be related immediately to the appropriate personnel for taking action and/or may be stored in the database for server 325 and included in periodic reports or made available for on-demand retrieval based

on flexible retrieval criteria specified by authorized personnel. Also, server 325 may query individual vending machines 10 for any desired information generated by and/or stored by such vending machines 10. Such queries may be made pursuant to automated programming instructions executed by server 325 or may
5 be made on an ad-hoc basis by one of the end users 341 or 342 through server 325. As a result, both real-time data and historical data may be made available to an extent not previously available with conventional newspaper vending machines.

10 *Additional Detail Regarding System Sensors*

As indicated above, a primary purpose of the system 20 of the present invention is to provide a low-inventory message in the event that the quantity (typically defined by the weight of the newspapers or the height of the newspapers, and as measured by the weight/height sensor 35) of newspapers
15 within container 12 drops below a threshold. That threshold, in turn, may be either fixed by the hardware (e.g., where a pushbutton switch is used as a weight sensor) or may be set in the software, as described in more detail below.

In the preferred embodiment of the invention, a simple low-pressure, normally closed, spring-loaded depression switch (i.e., one type of weight sensor
20 30) is used for this purpose. Of course, it is also possible to instead use a normally open switch, provided that the remainder of the circuitry is configured appropriately (e.g., by using an inverter). Preferably, the weight of even a single newspaper is sufficient to open the switch. However, in alternative
25 embodiments, the weight of two or more newspapers may be required to open the switch. This design choice will determine whether a low-inventory message is transmitted while one or more newspapers remain within the newspaper vending machine, or whether the low-inventory message is only transmitted once the newspaper vending machine is completely empty (i.e., a sellout condition).

30 As will be readily appreciated, the following techniques are useful for measuring a stack of newspapers 13 without any special preparation and without inserting anything between individual newspapers within the stacked 13. Thus, the bottom surface of one newspaper contacts the top surface of the newspaper underneath that along substantially the entire surfaces of such newspapers.

Figure 7A illustrates a portion of a newspaper vending machine 10 that utilizes a pressure-detection mechanism 30, such as the low-pressure switch described above. As shown in Figure 7A, pressure-detection mechanism 30 is mounted on the bottom surface 11 of the inner container 12 of vending machine 10. In this manner, pressure-detection mechanism 30 provides signals indicative of the amount of inventory within newspaper vending machine 10. In the case where the above-described normally closed low-pressure switch is used as pressure-detection mechanism 30, when a stack of newspapers 13 having sufficient weight (preferably, as noted above, only a single newspaper is necessary) is placed within vending machine 10, the switch remains open. However, once the stack of newspapers 13 is sufficiently depleted (e.g., completely depleted), the switch returns to its normally closed position.

The purpose of the switch in this embodiment of the invention is to provide a signal when a low-inventory condition occurs. The use of such a switch can provide the low-inventory signal very inexpensively. Accordingly, its use is particularly efficient where one only wishes to know whether newspaper vending machine 10 is completely empty or still has at least one newspaper within it. Generally, however, the use of a switch is less effective where one wishes to be notified prior to complete depletion of the newspaper inventory. This is because the triggering weight of such a switch may be difficult to set precisely and because the weight of a single newspaper generally will vary from day to day.

Where a more precise inventory control mechanism is desired, an analog pressure sensor 30 (as opposed to switch 40, which is a binary pressure sensor), such as a piezoelectric sensor or a spring-mechanism scale, generally is more preferable. It is noted that, although an analog pressure sensor 30 may be used, the analog signal preferably is converted into a digital format (either within the sensor itself or, for example, in processor 102) in order to facilitate subsequent processing.

Still further, although a pressure sensor 30 (binary or analog) is preferred for detecting the amount of inventory in a newspaper vending machine according to the present invention, other types of inventory detection mechanisms also are contemplated. Instead of detecting the weight of the stack of newspapers 13 within newspaper vending machine 10, an appropriate

inventory detection sensor may, for example, detect the height of the stack of newspapers 13.

This can be accomplished, for example, using a simple mechanical device 410, such as is shown in Figure 7B. Device 410 includes an upper arm 412 and an extension arm 414 which together form an "L" shape and are weighted such that upper arm 412 presses downwardly onto the stack of newspapers 13. In addition, or instead, upper arm 412 may be spring-biased so as to press downwardly onto newspaper stack 13. Extension arm 414 fits within an elongated hollow receiving element 415 that is disposed beneath the bottom surface 11 of the newspaper vending machine 10. Element 415 preferably includes a stop to prevent extension arm 414 from being completely removed therefrom. Otherwise, extension arm 414 is free to slide into and out of receiving element 415. In this manner, the height of the newspaper stack 13 can be determined by measuring the distance with which extension arm 414 is inserted into receiving element 415.

This distance, in turn can be measured in a variety of different ways. For example, receiving element 415 may be wound with thin-gauge wire to form an electrical coil and extension arm 414 may be formed in the manner of an inductor core, from steel, iron or a similar metal. In this embodiment, as extension arm 414 is inserted further into receiving element 415, the inductance of the electrical coil increases and, therefore, the height of newspaper stack 13 can be estimated by measuring the inductance of the coil using any known conventional technique.

Alternatively, the height of newspaper stack 13 may be determined by providing receiving element 415 with a resistance element along its length and providing extension arm 414 with an electrical brush terminal that contacts such resistive element as it travels within element 415. In this manner, an estimate of the height of newspaper stack 13 can be easily obtained by tapping the electrical terminal on extension arm 414, tapping one end of the resistive element in receiving element 415, and measuring the resistance between those two points.

In a still further embodiment, the height of newspaper stack 13 may be determined, as shown in Figure 7C, using an electric eye 420 that consists of a light source 422 (which is disposed on one side of the interior container 12 of newspaper vending machine 10) and a light sensor 424 (which is disposed on

the other side of the interior container 12, preferably at the same height as light source 422, and oriented so as to detect light from light source 422). When such a sensor 420 is utilized, a trigger signal may be generated when sensor 424 detects light from light source 422, meaning that the height of the newspaper stack 13 has fallen below the level of the electric eye. Thus, this mechanism functions as a binary height-detection sensor, detecting only whether the height is below or above a particular threshold.

Lastly, as shown in Figure 7D, the height of newspaper stack 13 may be measured by mounting any of a variety of different electronic distance-measuring devices on the top surface 15 of container 12. Such electronic distance-measuring devices typically are configured as a transceiver that emits a pulse or beam of energy and then detects the energy reflected off a target surface in order to determine the distance to such surface. The transmitted energy may be, for example, ultrasonic or laser energy. The transmitter 430 may be separate from the receiver 434 (as shown in Figure 7D) or else the transmitter 430 and receiver 434 may be housed within the same unit.

As shown in Figure 7D, the transmitter 430 may direct the energy vertically downwards 431 toward the stack of newspapers 13 (in which case it may be preferable to house the transmitter 430 and receiver 434 in the same unit) or may direct the energy at an angle 432 toward the stack of newspapers 13. The latter technique can have the effect of increasing the round-trip distance that the energy must travel from the transmitter 430 back to the receiver 434 (which may be advantageous in situations where very short distances are difficult to measure). Moreover, where a laser distance detector is being used, the latter technique provides the opportunity for using a different technique to estimate the subject distance, e.g., by using a charge-coupled device (CCD) to measure the lateral position of the laser spot 435 across the stack of newspapers 13, which lateral position will change as the height of stack 13 changes.

Figure 8 illustrates a left-side cross-sectional view of a newspaper vending machine 10 having a tilt sensor 140 connected to an alarm circuit 160, which in turn is connected to a siren 165. In the present embodiment of the invention, tilt sensor 140 is a simple normally open spring-loaded pushbutton switch which is mounted to the bottom surface of newspaper vending machine

10. Accordingly, the weight of newspaper vending machine 10 against the ground 450 depresses the pushbutton, keeping the contacts of switch 140 open. However, if newspaper vending machine 10 is tilted sufficiently to raise pushbutton switch 140 off of the ground 450, the pushbutton returns to its normal state, closing its contacts and thereby providing a signal to alarm circuit 160. In order to provide equivalent tilt detection in all directions, pushbutton switch 140 preferably is mounted near the center of the bottom surface of newspaper vending machine 10 (assuming a rectangular bottom surface). In the embodiment shown in Figure 8, the alarm circuit 160 and a siren 165 are mounted in the bottom section 452 of newspaper vending machine 10 (i.e., underneath container 12). However, in alternate embodiments these components may be mounted anywhere within newspaper vending machine 10.

Figure 9A illustrates a left-side cross-sectional view of a newspaper vending machine 10 that includes plural digital security cameras 200. As shown, such cameras 200 are triggered by the opening of access door 16. One of the security cameras 200 is mounted on the rear wall of container 12, oriented in an angled manner so as to have a line of sight over the top of the stack of newspapers 13 that permits viewing of customers' faces as they are opening access door 16. Another of the security cameras 200 is mounted on the front bottom surface of container 12 and oriented so as to point at a small angle away from straight up. In each case, the goal is to provide a line of sight out through access door 16 when door 16 is open. In the preferred embodiments of the invention, access door 16 opens up to an angle of approximately 45 degrees. Generally speaking, therefore, it will be preferable to orient any such security camera 200 at a similar angle. Either or both of the security cameras 200 shown in Figure 9A may be utilized or, alternatively, a security camera 200 may be placed in any other position within newspaper vending machine 10. Currently, it is preferred to use a single security camera in one of the positions shown in Figure 9A.

In any event, each security camera 200 utilized preferably is camouflaged (e.g., hidden behind a one-way mirror or enclosed in a container with only a small opening for the lens) so as to be not readily detectable by the customers. This is desirable because any awareness of the security camera 200 may result in actions intended to defeat its effectiveness.

In the preferred embodiments of the invention, a security camera 200 takes a photograph every time access door 16 is opened. This is because the opportunities for capturing an image of the customer generally will be very limited and the determination as to whether a theft has occurred usually can only
 5 be made after the opportunity for taking such a photograph has passed.

Thus, in these preferred embodiments some mechanism must be provided for triggering the camera when access door 16 is opened. Where an ordinary off-the-shelf digital camera is utilized as security camera 200 it may be possible to utilize an electrical switch in connection with an override of the
 10 camera's provided pushbutton switch. Such a switch may be used in connection with a delay circuit, with the amount of delay determined empirically to optimize the likelihood of capturing an image of the customer's face, such as a delay of a few seconds after access door 16 has been opened.

However, a simpler mechanism for accomplishing the same result is shown in Figures 9A and 9B. As shown in Figure 9A, a length of flexible tubing
 15 502 is provided between the digital camera 200 and an activation bulb 504. Activation bulb 504 preferably is configured as a flexible bulb, such as is used to pump up a blood pressure cuff, and the flexible tubing 502 preferably is fitted over the trigger switch of camera 200. Accordingly, when the bulb 504 is
 20 compressed, a pulse of air pressure travels along tubing 502, causing the camera's trigger switch to depress and thereby causing camera 200 to take a photograph.

Figure 9B more clearly illustrates how bulb 504 may be compressed when access door 16 is opened. In many conventional newspaper vending machines
 25 10, near the bottom of access door 16 (i.e., near the hinge) both the access door 16 and the main portion 510 of vending machine 10 are provided with corresponding L-shaped structures 512 and 514, respectively. These structures 512 and 514 contact each other when access door 16 is tilted open a predetermined amount, thereby preventing access door 16 from being opened
 30 any further (typically, access door 16 is limited to being opened at an angle of approximately 45 degrees). By placing bulb 504 between these two structures 512 and 514, bulb 504 will be compressed each time access door 16 is opened. Alternatively, bulb 504 may be placed anywhere else within vending machine 10 where it will be compressed upon the opening of access door 16, such as

underneath a door arm. As noted above, the compression of the bulb 504 provides an air poll which depresses the pushbutton trigger switch of security camera 200.

5 The foregoing embodiment allows the use of a conventional off-the-shelf camera 200, thereby reducing costs. However, where a special-purpose camera is utilized for security camera 200, additional functionality may be provided. For example, although each customer is photographed when access door 16 is opened, such a special-purpose camera may be configured so as to delete the photographs of the customers after processor 102 determines (based on its
10 sensor inputs) that no theft has occurred. Similarly, it is possible for camera 200 to take multiple photographs of the customer (e.g., by triggering the camera 200 multiple times upon receipt of a signal from door sensor 22) or even a segment of full-motion video (e.g., using a timer to record a fixed length of video upon receipt of the trigger signal) in connection with each transaction. In such
15 embodiments, deleting non-relevant images, as indicated above, will be particularly useful in order to conserve available storage memory.

Alternatively, a similar result may be achieved by using a digital camera 200 that has a fixed amount of memory and overwrites the previous images taken on a first-in-first-out basis when the memory becomes full. When such a
20 camera 200 is utilized, it generally will be preferable to upload (or otherwise designate for permanent storage) the relevant images when a theft, tilt or similar condition is detected, in order to prevent overwriting of important images. One technique for preserving images which does not require immediate uploading is to disable the energizing of camera 200, at least until the relevant images can be
25 uploaded or designated for permanent storage.

In certain embodiments of the invention, the digital camera used as security camera 200 will be powered by internal batteries which must be periodically charged or replaced manually. Therefore, there is some motivation to conserve battery power. Generally speaking, this would mean only energizing
30 security camera 200 immediately prior to its expected use. At the same time, however, most conventional digital cameras require a certain amount of initialization time after being powered up.

One solution to this problem is the use of a motion detector to detect motion near newspaper vending machine 10 and, upon such a detection, to

energize security camera 200. In the preferred embodiments of the invention, such a motion detector includes a passive infrared motion sensor powered by a 9-volt battery (or by stepping down the system power to 9 volts). Motion detector 205 preferably also includes a mechanical relay, or a similar electronic switch
 5 functioning as a relay, and a timer circuit. The relay is used for energizing the camera. When a signal is provided by the motion sensor, both the relay and the timer circuit are activated. The relay then remains closed until the timer circuit resets it (with the time period preferably being set by the user, e.g., from 1 minute to 10 minutes), thereby turning off (or de-energizing) camera 200.
 10 Alternatively, many conventional digital cameras include timer circuits which cause the camera to power down after a certain period of nonuse; when such a camera is used as camera 200, it may be possible to avoid using a separate relay and timer circuit.

15 *Processing Within the Vending Machine*

Generally speaking, it is preferable to tailor the software implemented on processor 102 to the particular weight/height sensor 35 utilized. Thus, for example, if weight/height sensor 35 is a simple pushbutton switch, then the corresponding input on processor 102 may be configured as an interrupt. Where
 20 an analog weight or height sensor 35 is utilized, it generally will be preferable to poll the corresponding sensor input at periodic intervals and/or whenever access door 16 is opened.

Also, if an analog weight/height sensor 35 is utilized, it generally will be necessary to specify a threshold at which the low-inventory condition will be
 25 declared. This threshold may be a fixed weight or height, as the case may be, in order to provide a general indication as to when a low-inventory condition has occurred. Alternatively, processor 102 may be configured so as to estimate an actual count of newspapers within container 12 based on the measured weight or height. Because of the day-to-day (or even edition-to-edition) variations in the
 30 size of the newspaper, this generally will require the provision of processor 102 with an indication of the weight or height, as the case may be, of a single newspaper currently in container 12. This information may be provided in a number of different ways. For example, once the inventory has been replaced by a service worker, the service worker may transmit a message to the

communications server 325 (e.g., using a wireless PDA) indicating that this is the case and identifying the particular newspaper vending machine 10; in response, server 325 automatically would download the information to such newspaper vending machine. Alternatively, if a short-range wireless receiver or transceiver 112 has been incorporated into the system 20, then the service worker may be provided with a compatible PDA to transfer the information directly into system 20.

In any event, any configuration combining an analog weight or height sensor with knowledge of the actual weight or height of each individual newspaper will permit processor 102 to estimate, at any desired time, the actual number of newspapers present within container 12. Beyond the ability to transmit messages when a specified low-inventory condition has occurred, such capability also can be used for other purposes as well. For instance, in connection with input from door sensor 22, processor 102 can use such information to determine when a theft has occurred (e.g., by determining if more than one newspaper has been removed when the access door 16 has been opened only once).

Still further, such information can be used to track sales volume on an hourly (or even continuous) basis, thereby better enabling sellers to determine how a variety of different conditions (including time of day, breaking news events, events occurring in the near vicinity of the vending machine 10, and/or displayed messages, as discussed in more detail below) affect sales. For example, processor 102 may be programmed to record inventory periodically (or even to record the time that each individual sale is made and, in certain embodiments, the number of newspapers actually taken during the transaction) and then to either immediately report such information to server 325 (e.g., via the communications server 310) or to store such information and then transmit it in a batch mode (e.g., at the end of the day when transmission rates are lower).

After an initial detection of a low-inventory condition, it generally is preferable to wait a period of time before transmitting a low-inventory message. Currently, a 5-second delay is preferred. If the inventory remains low after the specified delay, the low-inventory message is then sent. The use of such a delay can prevent false alarms, particularly in situations such as where the inventory within newspaper vending machine 10 is being replaced by a service

worker. Alternatively, it is possible to provide functionality for disabling the transmission of low-inventory messages at certain times, e.g., for use during such inventory-replacement operations. For example, a local wireless communication instructing such disablement may be sent (either automatically or manually activated) from a device carried by the service worker performing the inventory replacement to the short-range transceiver or receiver 112.

Subject to any such delay, the low-inventory message preferably is sent immediately or nearly immediately upon the detection of the low-inventory condition. In addition to identifying the low-inventory condition, the message preferably also includes an indication of the location of the newspaper vending machine 10 transmitting the message. This latter indication may be an actual specification of a location or instead may be an identification code associated with the newspaper vending machine 10 that server 325 may look up in a database to determine the location. More preferably, however, this information is provided as an address of the vending machine 10, appropriate notes regarding the exact location at that address, and an active Uniform Resource Locator (URL) address that provides an Internet link to an image of a map of the exact location of the newspaper vending machine 10.

If the system 20 has been configured only to send low-inventory messages, then any message received from a particular modem/transmitter 104 may be interpreted as a low-inventory message. However, the present invention contemplates a variety of different and flexible possible messages from each system 20. In the present embodiments of the invention, both the satellite modem/processor 100 and the cellular modem/processor 100 provide a "notes" field that allows customization of a message generated by the system 20. Although the manufacturers of the modem/processors 102 generally contemplate that this "notes" field will be used for information regarding the modem 104, the present invention uses the field more generally, as described below. This "notes" field may contain the URL (or other location designation) described above and also may contain information regarding the nature of the message (e.g., "sellout", "theft", "refilled" or "tilt"), as well as any data parameters that need to be uploaded to report server 325.

In the current embodiments of the invention, the modem/processor 102 is programmable in a similar manner to a programmable logic controller (PLC),

primarily utilizing "if..., then..." statements. System 20 utilizes this capability by generating and transmitting messages in response to specified events.

Currently, the preferred processing and messaging arrangement is as follows:

1. After a sellout signal has been provided by a momentary
5 pushbutton switch functioning as weight sensor 30 for a 5-second period of time, processor 102 sends a message via modem/transmitter 104 and antenna 106, the message containing the unit number of newspaper vending machine 10 (which is unique and therefore uniquely identifies vending machine 10 and, accordingly, the location of vending machine 10) and an event code indicating a
10 sellout situation. In the preferred embodiments, the same message also includes the date and time of any previously unreported openings of coin-box access door 19 (as recorded in condition No. 3, below).

2. When the newspapers are replenished in container 12, switch 30 is depressed into the open position, thereby opening its contacts. In response to
15 the corresponding signal cutoff (and in certain embodiments, after a delay, e.g., a 5-second delay), processor 102 sends a message: (i) indicating that the newspaper vending machine 10 has been refilled, and (ii) including the unit number and the word "refilled". The message body may also include, in addition to the unit number, the address of the vending machine 10 and a link to a map
20 showing the location of the vending machine 10.

3. When the coin-box access door 19 is opened, a normally closed momentary pushbutton switch or a normally closed reed switch functioning as coin-box of sensor 24 is released and a positive voltage signal is provided to processor 102 on a second digital input. This input is programmed to trigger an
25 event in which the time, date and an event code indicating the emptying of the coin box are recorded by processor 102.

4. Any of the information pertaining to coin-box access recorded pursuant to condition No. 3 above that has not already been reported to server 325 in connection with a sellout (see condition No. 1 above), together with the
30 status of the inventorsy in container 12 (sellout or some inventorsy remaining), is included in a message sent at midnight each night by processor 102 to server 325 (e.g., via communications server 310).

5. If a tilt signal is provided to processor 102, a message indicating this, together with the location of the newspaper vending machine 10

immediately is sent to server 325. It is noted that a siren 165 (preferably, a small piezo siren) in the vending machine 10 is activated by the same tilt sensor 140.

6. The system 20 includes a low-voltage detector which detects when the voltage of battery 40 falls below a specified threshold and provides an input signal to processor 102 indicating this fact. In response, processor 102 sends a message to server 325 (e.g., via communications server 310) indicating this fact, together with the unit number or other information indicating the location of the newspaper vending machine 10.

As indicated above, the foregoing messaging and processing currently is preferred. However, system 20 preferably is flexible enough to accommodate a wide range of processing and messaging, depending upon the capabilities of modem/processor 100. For example, one of the events that might trigger a message from modem/processor 100 might be a query message received from report server 325 requesting specific information, in which case the responding message from modem/processor 100 would provide the requested information (e.g., the current amount of inventory, the current number of sales, the voltage of battery 40, the voltage or current been provided by solar cell 240, and/or any other diagnostic information) on a real-time basis. Of course, any such information and also may be provided by system 20 without the need for an external query, on an event basis and/or on a periodic reporting basis.

Similarly, other conditions of newspaper vending machine 10 or system 20 in particular may be monitored and reported on a query basis, event basis and/or periodic reporting basis. For example, processor 102 might poll door sensor 22, and if access door 16 remains opened for a specified minimum period of time, the information (indicating a possible prop-open situation, other inappropriate behavior or a malfunction) may be recorded and/or reported to server 325. In addition, processor 102 may be configured to accept instructions through modem/transmitter 104 requesting a current image; in response, processor 102 would cause security camera 200 to take a photograph (or a segment of video) and to upload those images to server 325, thereby providing an on-demand monitoring system.

As indicated above, newspaper vending machine 10 preferably is capable of tracking and recording a number of different events (e.g., each time access door 16 is opened, each time coin-box access door 19 is opened, each time a tilt

occurs or each time a theft occurs) based upon time of day. In the preferred embodiment of the invention, this is accomplished using a clock that is internal to processor 102 to time-stamp and/or to date-stamp each event to be recorded for which such information is desired. It is, of course, also possible to upload the event information immediately and have server 325 provide any desired date and/or time stamps. However, one disadvantage of this alternate method is that there likely will be some time lag between when the event occurs and when server 325 receives the corresponding information and is able to time stamp it.

10 *Server Processing*

Report server 325 preferably is a standard query language (SQL)-based server having the primary functions of receiving messages from the various newspaper vending machines 10, parsing those messages, storing the information into its database and sending pre-specified alert and reporting e-mail messages, both on a real-time basis (e.g., in the case of a sellout or a tilt) and on a scheduled basis (e.g., for periodic reporting purposes). For example, in the event of a low-inventory condition (e.g., a complete sellout), a low-battery-voltage condition or a tilt condition, an e-mail message preferably is automatically generated and transmitted to a predesignated recipient list upon receipt of the corresponding message from the affected newspaper vending machine 10. Each such e-mail preferably would indicate the type of event, the location of the affected newspaper vending machine 10, and a link to a map showing such location. If processor 102 has not been configured to embed a link to a map showing the location of the corresponding vending machine 10 in the message that it transmits, then server 325 may be configured to create such a link based upon the received unit number (which uniquely identifies the vending machine 10 and, accordingly, the location of the vending machine 10) and embed the link in the e-mail message (or the SMS message or any other real-time message) that it transmits. In addition to these real-time notifications, server 325 preferably is configured to send, e.g., by e-mail, periodic (e.g., each morning at 6 AM) status reports regarding the conditions of the various newspaper vending machines 10.

In addition, the information pertaining to the newspaper vending machines 10 stored in report server 325 preferably can be accessed, sorted and used to

generate specifically tailored reports in a similar manner to that provided by conventional SQL-based servers. The following describes the currently preferred processing, database and reporting functionality provided by report server 325.

- 5 1. Historical data regarding the newspaper vending machines 10 is searchable by activity (e.g., refills, number of times access door 16 was opened, number of times coin-box access door 19 was opened), numbers of papers loaded, papers sold, area by individual units and by groups, the reports being customizable by current day, day of week, specific day of week over a period of
10 time, weeks, month. It is noted that some of the information may be provided directly by the newspaper vending machines 10 through network 300, some of the information in may be provided automatically by other devices (e.g., and wireless handheld devices carried by the service workers), and/or some may be input manually by end users 341 and 342.
- 15 2. The history reports are exportable upon request and sent every morning by 6am.
3. The draws (amount of papers sold) are imported into the database maintained by server 325, which preferably is accessible by the Web page maintained by server 325, in order to load the draw for the next day. In addition,
20 data is exported into a separate circulation management system.
4. When a sellout occurs , and email is sent with a link to a map of the location of the corresponding newspaper vending machine 10.
5. The Web site maintained by server 325 allows end users 341 and 342 to pull up a map showing where the sellouts (or low-inventory machines 10)
25 are located, with each pinpointed on the map. In alternate embodiments of the invention, the map may be configured to indicate any of a variety of different user-selected criteria, e.g., for each newspaper vending machine 10 and the quantity of newspapers remaining in such vending machine 10, any newspaper vending machines 10 having experienced theft within the past 24 hours, and/or
30 any other information pertaining to the newspaper vending machines 10.
6. The addresses and all other information pertaining to each newspaper vending machine 10 is editable through the Web site maintained by server 325.

7. When a sellout (or a low-inventory condition) occurs, a pop-up window comes up on the Web site maintained by server 325, indicates the sellout and includes location information for the affected newspaper vending machine 10.

5 8. When the amount of papers sold it does not match the amount put it in and a sellout (or low-inventory condition) occurs, a special pop-up and email is sent alerting the appropriate personnel to possible rack theft.

9. The text on the Web page turns red when any newspaper vending machine 10 sells out.

10 10. The end users 341 and 342 have the option to add information into fields on the Web page, such as: the type of paper (e.g., rated as 1a, 1b, 1c, 2a, 2b, 2c, 3a, 3b, 3c), a check box showing if stories in the newspaper were advertised via, radio, television or rack cards. This information also can be used as sort criteria for exportable reports and online history. In the foregoing
15 descriptions, the ratings describe the content of the newspaper front page as follows: 1 stands for international, 2 stands for national, 3 stands for regional, 4 stands for local, a stands for disaster, b stands for crime, c stands for political, etc.

11. An e-mail is sent when the battery power is low on any newspaper
20 vending machine 10, together with location information for the vending machine 10.

Messaging Display

Figure 10 illustrates a newspaper vending machine assembly 550 that
25 includes a newspaper vending machine 10 having a system 20 (as described above) with transceiver capabilities. In addition, assembly 550 includes a post 552 extending vertically from behind newspaper vending machine 10. Post 552 may be mounted to vending machine 10 more may be separately mounted to the ground in close proximity to vending machine 10. In any event, post 552
30 preferably extends at least three feet above the top of newspaper vending machine 10. At the top of post 552 is a display assembly 554 that includes a display panel 557, a light source 560 and a solar cell 240. Post 552 provides a conduit for the electrical connections between system 20 (within newspaper

vending machine 10) and display assembly 554, as well as providing the physical support for display assembly 554.

5 In the preferred embodiments of the invention, post 552 and display assembly 554 are aesthetically matched to newspaper vending machine 10 so as to appear as a single unit, thereby increasing the recognition of newspaper vending machine 10. Thus, for example, post 552 and display assembly 554 may be painted in the same colors as vending machine 10, may be painted so as to complement vending machine 10, and/or may have similar or identical logos as vending machine 10. In any event, each combination of vending
10 machine 10, post 552 and display assembly 554 preferably is designed to look similar or identical to each other such combination carrying the same branded newspaper.

Display panel 557 preferably is implemented as an electronic link display, such as is provided by E Ink Corporation. This display involves millions of tiny
15 microcapsules, about the diameter of a human hair. Each microcapsule contains positively charged white particles and negatively charged black particles suspended in a clear fluid. When a negative electric field is applied, the white particles move to the top of the microcapsule where they become visible to the user. This makes the surface appear white at that spot. At the same time, an
20 opposite electric field pulls the black particles to the bottom of the microcapsules where they are hidden. By reversing this process, the black particles appear at the top of the capsule, which now makes the surface appear dark at that spot. The ink is printed onto a sheet of plastic film that is laminated to a layer of circuitry. The circuitry forms a pattern of pixels that can then be controlled by a
25 display driver.

Alternatively, display panel 557 may be implemented as a liquid crystal display (LCD) a light-emitting diode (LED) display, an organic light-emitting device (OLED), or any other display device. One example of an OLED display is that manufactured by Lite Array Incorporated. The main considerations in
30 selecting an appropriate display panel 557 generally will be to reduce: initial purchase price, power consumption and likely replacement and/or repair costs. These considerations may lead to different choices for display panel 557 as technology evolves.

Light source 560 preferably is a relatively low-power light source, such as a LED array. However, light source 560 instead may be any other light source. It is noted that light source 560 main function as load 280 (described above). Alternatively, light source 560 may be switched on and off so as to be powered
5 generally only during the nighttime, using a timer circuit or using an ambient light sensor (not shown). Light source 560 is intended to function as a security light for newspaper vending machine 10 and to illuminate display panel 557. In certain embodiments, light source 560 may be omitted entirely, particularly where display panel 557 itself generates sufficient light to permit viewing of the
10 displayed message (e.g., a LED display). Even in such an event, however, it may still be desirable to provide light source 560 in order to illuminate newspaper vending machine 10 during the nighttime hours, both for security purposes and to increase the visibility of vending machine 10 in an attempt to increase nighttime sales.

15 In this embodiment of the invention, solar cell 240 is disposed on the top surface of display assembly 554. In alternate embodiments, an antenna 106 may instead (or in addition) be mounted on the top surface of display assembly 554. In further embodiments, the system antenna 106 (e.g., a whip or similar antenna) may be disposed within pole 552 or may extend from the top of display
20 assembly 554.

Figure 11 illustrates a block diagram of a system 20 that includes a display panel 567. In Figure 11, the input sensors (such as weight/height sensor 35, access door sensor 22, coin-box sensor 24, security camera 200, and tilt sensor 140), together with their related circuitry (such as alarm circuit 160 and
25 siren 165), generally are designated as element 565. Display panel 557 receives information from processor 102 through display processor 567.

In the preferred embodiments of the invention, report server 325 will originate information to be displayed at display panel 557. Report server 325 then causes this information to be transmitted to modem/transceiver 104 (e.g.,
30 through communications server 310), typically in ASCII format, together with any desired display parameters (e.g., any desired display formatting and/or any preferences as to when the information is to be displayed). Alternatively, it may be assumed that any display information is to be displayed immediately, and the formatting may be pre-specified and/or specified locally by processor 102. In the

simplest embodiments, processor 102 simply parses out the display information and outputs it to display processor 567. In more complicated embodiments, processor 102 may add formatting to the received display information, add instructions for integrating the new display information with information already
5 being displayed, and/or perform any other processing.

In any event, processor 102 preferably outputs the display information in ASCII format (or in embodiments where graphics, images or other display elements are to be displayed, in a corresponding high-level format, e.g., JPEG, TIFF, PDF or a printer driver format). Display processor 567 and then takes this
10 information and converts it into bit data and then into a format that is appropriate to drive the particular display panel 557 that is being used. In addition, display processor 567 preferably performs other low-level functionality for causing the display information to be displayed in the manner described by the instructions received from processor 102 (e.g., causing text to roll across the display screen;
15 and/or causing display information to flash, change abruptly or dissolve into other display information).

As indicated above, the use of a display panel 557 in connection with a newspaper vending machine 10 may be readily accommodated by incorporating such a display panel 557 into the system 20 of the present invention. In this
20 manner, much of the necessary hardware can be multi-purposed: used both for uploading messages to report server 325 and also for receiving display information from report server 325. However, it also is possible to provide either the message-display functionality or the status-message-uploading functionality in a standalone system.

In either event, the network system for the display message functionality may be identical or similar to system 300, shown in Figure 6. Also, server 325 preferably has the ability to address messages containing display information individually to particular newspaper vending machines 10 (or to particular groups of the newspaper vending machines 10), so as to tailor the displayed messages
30 to the corresponding newspaper vending machine 10.

In the preferred embodiments of the invention, the display information provided by report server 325 relates to articles, advertisements or other material within the newspaper that currently is being sold from newspaper vending machine 10. For example, the display information may be in the form of a teaser

blurb that is intended to encourage consumers to purchase a copy of the newspaper and to read additional information about the displayed topic. Such a teaser blurb may actually be a portion (e.g., the beginning) of the article or other item in the newspaper. Where a portion of the text in the newspaper is displayed, it is preferable to include a significant portion of such text. This may include the headline or title of the article, or may include a particularly relevant, enticing and/or substantial quotation from the article. Where quotations are used, it is preferable to have a minimum of a five- or six-word quotation from the newspaper, although quotations may of course be longer or shorter. In addition, where the display information pertains to a particular article, series of articles or other item within the newspaper, it is preferable also to display the location of that item in the newspaper (e.g., the section and page number).

Similarly, the display information may advertise that the newspaper includes a coupon for a discount on a certain item. Such information may be displayed together with information regarding where to look in the newspaper for the coupon. As noted above, messages may be specifically tailored to each individual newspaper vending machine 10. Accordingly, the display message may be designed to correspond to a coupon from a vendor that is located within close proximity of the corresponding newspaper vending machine 10. Similar considerations apply to display messages that provide a teaser blurb about sales announcements and, in particular, about announcements of sales being conducted by vendors within close proximity of the corresponding newspaper vending machine 10.

Displaying messages that are related both to an item in the newspaper being sold and to the immediate or general geographic area in which the corresponding newspaper vending machine 10 is located may be quite effective as a general matter. For example, if the newspaper has material regarding a special event that is occurring in the neighborhood where the newspaper vending machine 10 is located, displaying a message saying that details regarding the event can be found in the newspaper may be effective at selling additional newspapers.

Generally speaking, it will be preferable to tailor the displayed messages to the individual newspaper vending machine 10, which messages preferably are significantly influenced by the location of the vending machine 10. For example,

a newspaper vending machine 10 in an area that has a great deal of office foot traffic may have different displayed messages than a newspaper vending machine 10 in an area that is more residential or commercial in nature.

As indicated above, in the preferred embodiments of the invention only binary monochrome print (e.g., black-and-white) text is displayed on display panel 557. However, given a display panel 557 that accommodates it, it also is possible to display graphics, line art or images, in binary print, grayscale or color.

In addition to geographic distinctions in the displayed messages among the various newspaper vending machines 10, in the preferred embodiments of the invention time distinctions also are made. It has been shown, for example, that online newspaper users generally are more interested in: breaking, local, national, business and sports news in the morning; breaking news, entertainment (including movie schedules), maps and directions, and offbeat news in the afternoon; and breaking news, shopping (including online-shopping and shopping for cars and homes), researching products for potential purchase and job hunting in the evening. See, e.g., MORI Research, "Online Departing: Claiming the Day, Seizing the Night," January, 2003. Thus, messages may be displayed in these categories at the indicated times of day.

However, it should be understood that the foregoing study pertains to online newspaper use. Different considerations might apply where the information is being displayed in a public venue. Thus, while the foregoing time-based distinctions are useful as a starting point, for the present purposes additional time-based distinctions also may be made, and those distinctions may be combined with geographic distinctions based on the locations of the vending machines 10.

For example, the location of a particular newspaper vending machine 10 may have one type of foot traffic during the workday and an entirely different type during the evenings and/or during weekends. Due to the significant number of variables involved with each specific location, as well as the fact that information displays according to the present invention have not previously been utilized, the optimal scheduling parameters presently are unknown. Accordingly, the preferred approach is to use the foregoing time-based distinctions identified by MORI Research as a starting point, but to modify these as is deemed

appropriate in view of known information regarding each specific location, and then to determine the ideal message-display schedule empirically.

In short, with respect to each newspaper vending machine 10, it is preferable to select the messages to be displayed on display panel 557 based directly on: the time of day that the message is to be displayed, geographic location of the newspaper vending machine 10, content within the newspaper edition currently in the newspaper vending machine 10, presently occurring events in the immediate vicinity of the newspaper vending machine 10, events occurring in the near future in the immediate vicinity of the newspaper vending machine 10, other presently occurring events, and/or other events occurring in the near future. Known statistical techniques (e.g., linear regression, nonlinear regression and neural network techniques) can be used to identify how specific values (or instances) of these variables affect the effectiveness of any particular display message, which information preferably is then used to modify the message-display schedule. In this manner, the message-display schedule is modified by ongoing feedback until such time, if ever, that generally applicable display rules are identified.

System Environment

As indicated above, many of the methods and techniques described herein can be practiced with a general-purpose processor. Such a processor typically will include, for example, at least some of the following components: one or more central processing units (CPUs), read-only memory (ROM), random access memory (RAM), input/output circuitry for interfacing with other devices and for connecting to one or more networks (which in turn may connect to the Internet or to any other networks), a display (such as a cathode ray tube or liquid crystal display), other output devices (such as a speaker or printer), one or more input devices (such as a mouse or other pointing device, keyboard, microphone or scanner), a mass storage unit (such as a hard disk drive), a real-time clock, a removable storage read/write device (such as for reading from and/or writing to a magnetic disk, a magnetic tape, an opto-magnetic disk, an optical disk, or the like), and a modem (which also may connect to the Internet or to any other computer network via a dial-up connection). In operation, the process steps to implement the above methods typically are initially stored in mass storage (e.g.,

the hard disk), are downloaded into RAM and then executed by the CPU out of RAM.

Suitable processors for use in implementing the present invention may be obtained from various vendors. Various types of computers, however, may be used depending upon the size and complexity of the tasks. Rather than a general-purpose processor, a special-purpose may instead be used. In particular, any of the functionality described above can be implemented in software, hardware, firmware or any combination of these, with the particular implementation being selected based on known engineering tradeoffs.

It should be understood that the present invention also relates to machine-readable media on which are stored program instructions for performing the methods of this invention. Such media include, by way of example, magnetic disks, magnetic tape, optically readable media such as CD ROMs and DVD ROMs, semiconductor memory such as PCMCIA cards, etc. In each case, the medium may take the form of a portable item such as a small disk, diskette, cassette, etc., or it may take the form of a relatively larger or immobile item such as a hard disk drive, ROM or RAM provided in a computer.

Additional Considerations.

As will be readily appreciated, the components of the present invention (including any or all of the components described above for system 20) generally can be easily installed (or retrofitted) into a conventional newspaper vending machine 10. However, it is also contemplated that newspaper vending machines 10 may be manufactured with the components of the present invention.

It should be understood that the network environment illustrated in Figure 6 above is illustrative only, and the actual network environment will depend upon the available communications systems that are intended to be used. For example, network 300 illustrated in Figure 6 extensively utilizes existing communications networks, requiring the operator to customize only its own vending machines 10 and report server 325. This reliance on existing communications systems is believed to significantly reduce the cost of implementing systems according to the present invention.

Similarly, in the above embodiments and the same server 325 is used for receiving messages originating from the vending machines 10, for sending queries to the vending machines 10, and for providing displayed messages to the vending machines 10. However, it should be understood that this
5 functionality may be divided among multiple servers. In fact, a cluster of servers operating in a load-balanced manner may be utilized to perform any or all of such functionality.

The components discussed above may be arranged and/or utilized in a variety of different ways in addition to those expressly described above. For
10 example, processor 102 may be configured to provide an output to alarm circuit 160, causing siren 165 to sound, in the event of a theft or similar event. Alternatively, processor 102 may be utilized to disable siren 165 under specified conditions. For example, it may be deemed more effective to simply record when theft and/or tilt events occur and to process that information, e.g., in
15 connection with information from other newspaper vending machines 10, in order to attempt to identify patterns that can be used to catch the perpetrators.

Data provided by the systems of the present invention can be utilized in novel ways to better target sales and to better anticipate when newspaper vending machines 10 are likely to need to be refilled. Thus, provided that an
20 analog weight/sensor 35 is used, real-time information regarding existing inventory in each vending machine 10 can be monitored and processed to identify usage patterns. These usage patterns, in turn, may be utilized to generate optimal or near-optimal service routes for refilling the newspaper vending machines 10. In this manner, the vending machines 10 can be refilled
25 more efficiently, requiring fewer personnel.

As indicated above, the sensor information provided by system 20 can be analyzed by server 325 in order to determine the effectiveness of information displayed on display panel 557, in terms of: time of day, geographic location, and contemporaneous events, both in the immediate location of each vending
30 machine 10 and otherwise. This effectiveness information can then be used to improve the displayed information on a per-machine basis and to shape both the type and arrangement of content that is included in the newspapers themselves.

Also, several different embodiments of the present invention are described above, with each such embodiment described as including certain

features. However, it is intended that the features described in connection with the discussion of any single embodiment are not limited to that embodiment but may be included and/or arranged in various combinations in any of the other embodiments as well, as will be understood by those skilled in the art.

5 In the embodiments described above, display panel 557 is used for displaying messages provided by server 325. However, processor 102 may be configured to utilize display panel 557 for other communications with customers and potential customers of the newspaper vending machine 10. In this case, display panel 557 preferably is positioned in a location that is suited to the
10 intended purpose. For example, if the communication concerns a sales transaction, display panel 557 may be mounted closer to access door 16. Still further, display panel 557 may be used to display information in connection with local communications via short-range transceiver 112, thereby providing the consumers with the ability to view visual information on a display screen that is
15 larger than what they would otherwise have on their compatible wireless telephone or PDA.

 The use of short-range transceiver 112 for communicating with service workers has been described above. In addition, short-range transceiver 112 may be used to communicate with passersby for a variety of different purposes.
20 For example, information regarding local businesses and/or events may be provided to passersby requesting such information. Also, passersby who previously have registered with the newspaper vendor may have the ability to download current news stories and/or other information into their PDAs via the short-range transceiver 112 in system 20, thus making the newspaper vending
25 machine 10 a one-stop information source for both up-to-date information and more in-depth information. With the use of such a communications link, a passerby might, for example, be provided with a menu of possible categories of information, select the desired categories and have the corresponding information downloaded to his or her PDA or, for an easier-to-read medium,
30 displayed on display panel 557.

 In the discussion above, functionality may be ascribed to a particular module or component. However, unless any particular functionality is described above as being critical to the referenced module or component, functionality may be redistributed as desired among any different modules or components, in

some cases completely obviating the need for a particular component or module and/or requiring the addition of new components or modules. The precise distribution of functionality preferably is made according to known engineering tradeoffs, with reference to the specific embodiment of the invention, as will be understood by those skilled in the art.

Thus, although the present invention has been described in detail with regard to the exemplary embodiments thereof and accompanying drawings, it should be apparent to those skilled in the art that various adaptations and modifications of the present invention may be accomplished without departing from the spirit and the scope of the invention. Accordingly, the invention is not limited to the precise embodiments shown in the drawings and described above. Rather, it is intended that all such variations not departing from the spirit of the invention be considered as within the scope thereof as limited solely by the claims appended hereto.